



Presented for the
Mass Cultural Council
11.06.2025

Cultural Facilities: Carbon Reduction & Electrification

New Ecology works nationally to bring the benefits of **sustainable development** to the community level, with a concerted emphasis on **underserved populations**.

A **mission-driven non-profit**, we seek to make the built environment more efficient, healthy, durable, and resilient.

THIS IS MANIFESTED IN OUR CORE WORK TO:

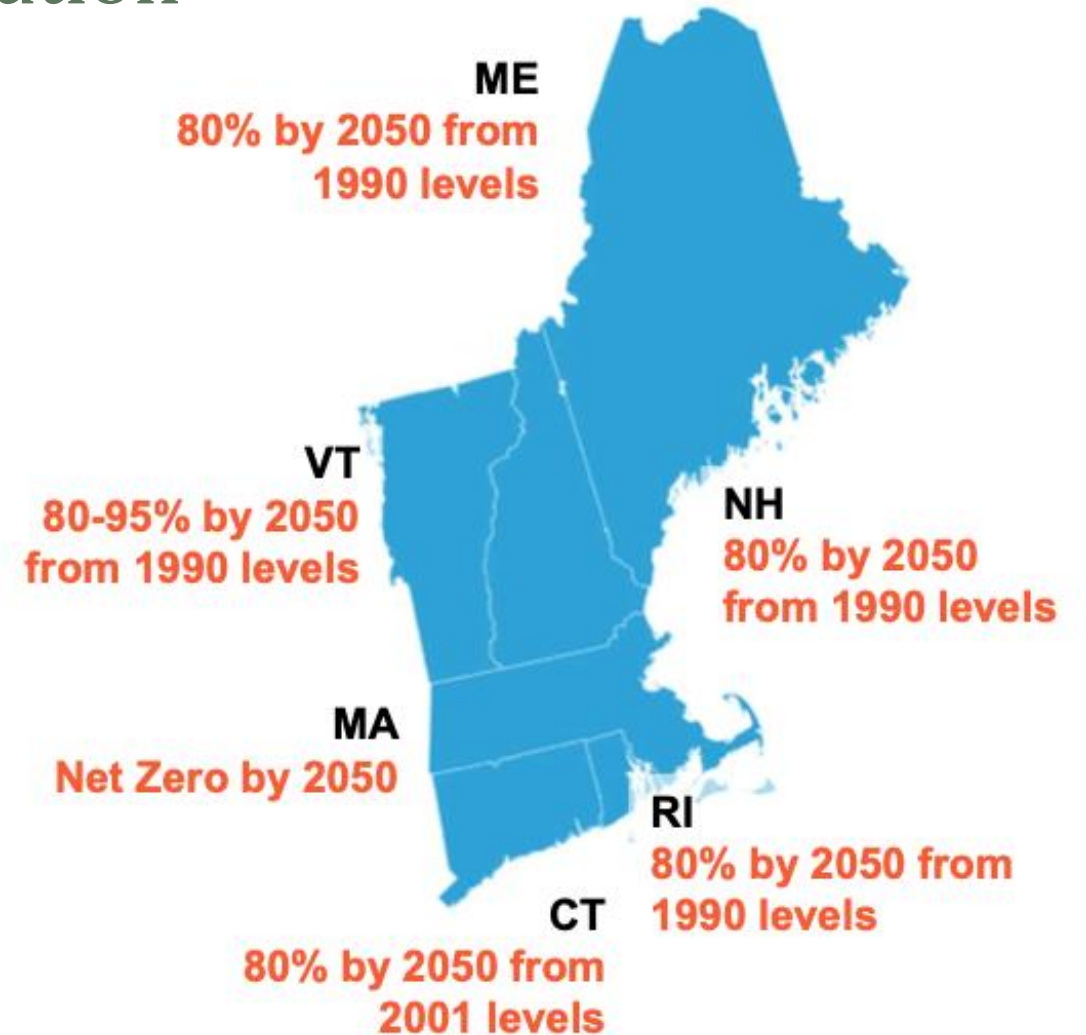
- **Research, test and implement** new approaches to sustainability, resiliency, healthy environments and energy efficiency;
- **Monitor, test, diagnose and solve** operational and building performance issues on existing buildings;
- Help **design, build, certify and operate** new high-performance buildings;
- **Share our learnings** with building professionals, contractors, government, financiers, owners and managers through education and training.

Terms

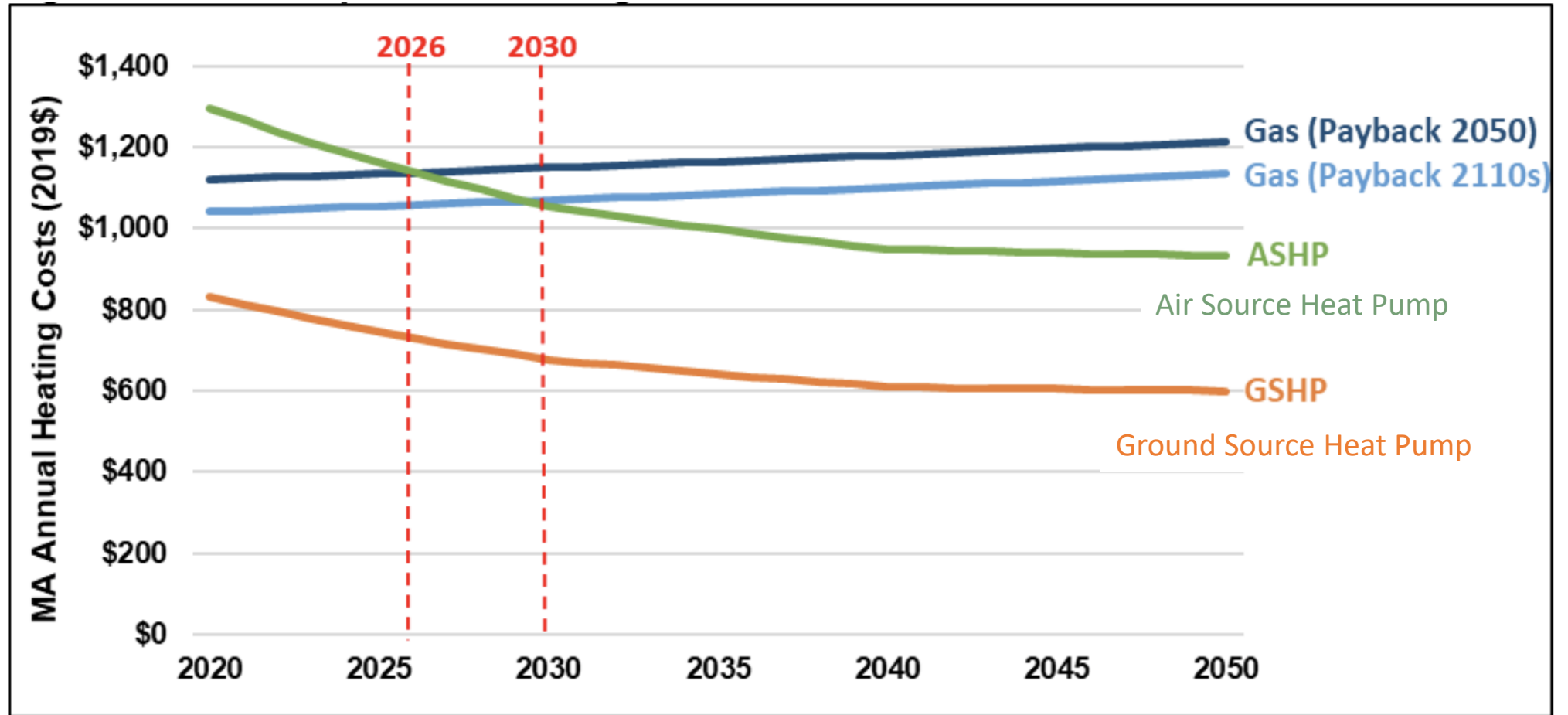
- *Net Zero* – removing greenhouse gas emissions from the atmosphere in an amount equal to what we are releasing into it
- *Decarbonization* – the result of actions taken to reduce or eliminate fossil fuel use by your building
- *Deep Energy Retrofit (DER)* – systematic forethought and intentionality that leads to investments and decisions over time that result in highly impactful energy savings and GHG emissions reductions
- CO_2_e –carbon dioxide equivalent is a standard unit of measure for emissions that includes nitrous oxide and methane (emissions from buildings - $\text{kg CO}_2_e/\text{sf}$)

Current Context for Decarbonization

- The State
 - Clean Energy and Climate Plan
 - Climate Bill H4515
 - Exec Orders 596
- “The Grid”
 - Reduce own emissions!
 - New load? Capacity?
 - Creating incentives



DRIVER: Fuel Costs



DRIVER: Local Benchmarking & Compliance Ordinances

Boston - Building Emissions Reduction and Disclosure Ordinance (BERDO)

REQUIREMENTS UNDER BERDO



Report your building's annual energy and water use every year by May 15

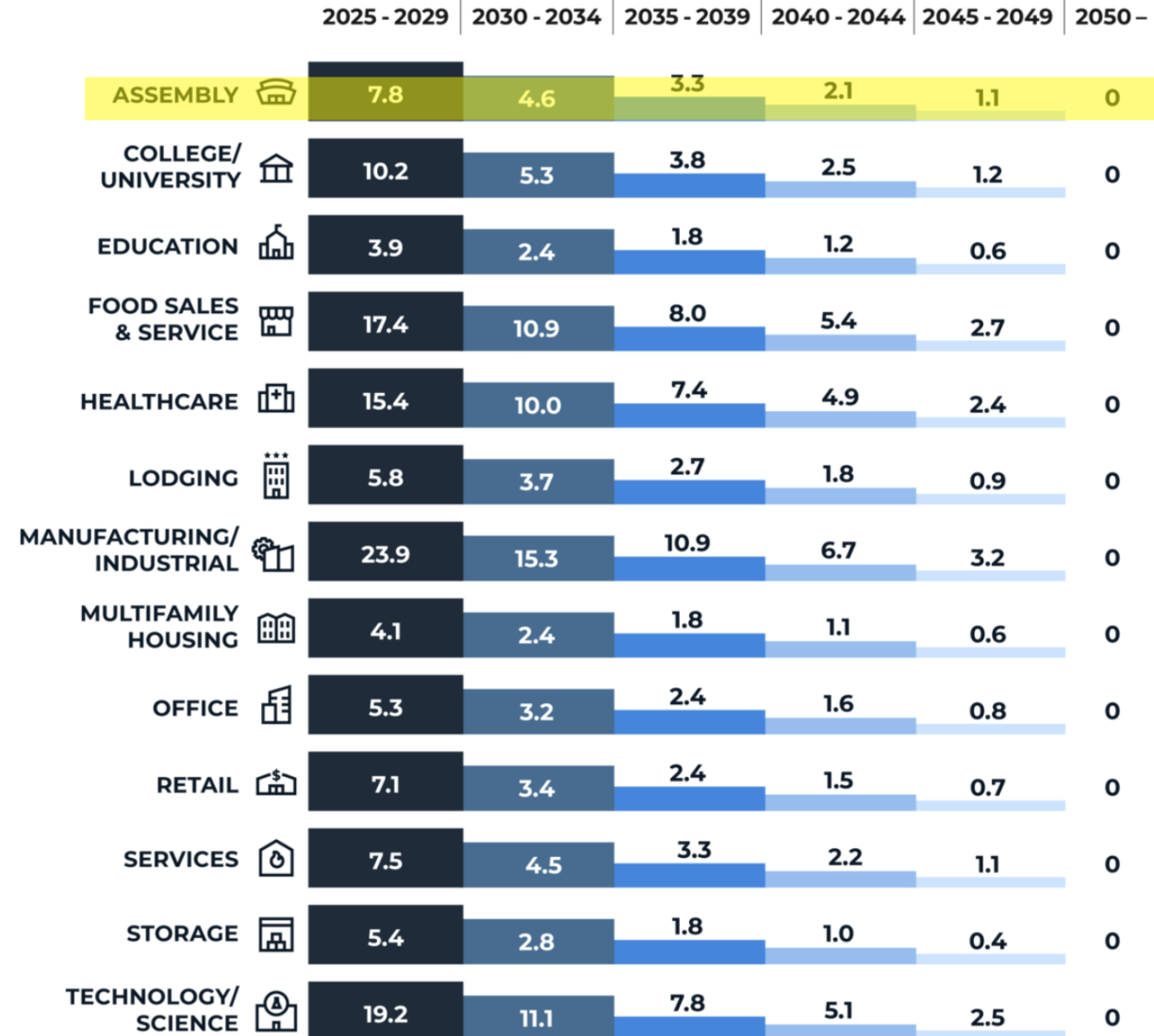


Verify reported data with a third-party qualified energy professional every verification year



Reduce emissions produced by your building(s) to comply with annual emissions limits

Alternative Compliance Payment: \$234 / metric ton of Greenhouse Gas Emissions



Emissions standard (kgCO₂e/ft²/year)

DRIVER: Local Benchmarking & Compliance Ordinances

Benchmarking + Performance Standards

Cambridge

- BEUDO: report data annually & show emissions reductions in comparison to past performance

Newton

- BERDO with flexibility reaching compliance targets over a long planning horizon

Benchmarking only

Chelsea

- BERDO requirements without complying to performance standards

Lexington

- BEU-D: reporting annual energy and water use

2022

U.S. City and State Policies for Existing Buildings: Building Performance Standards



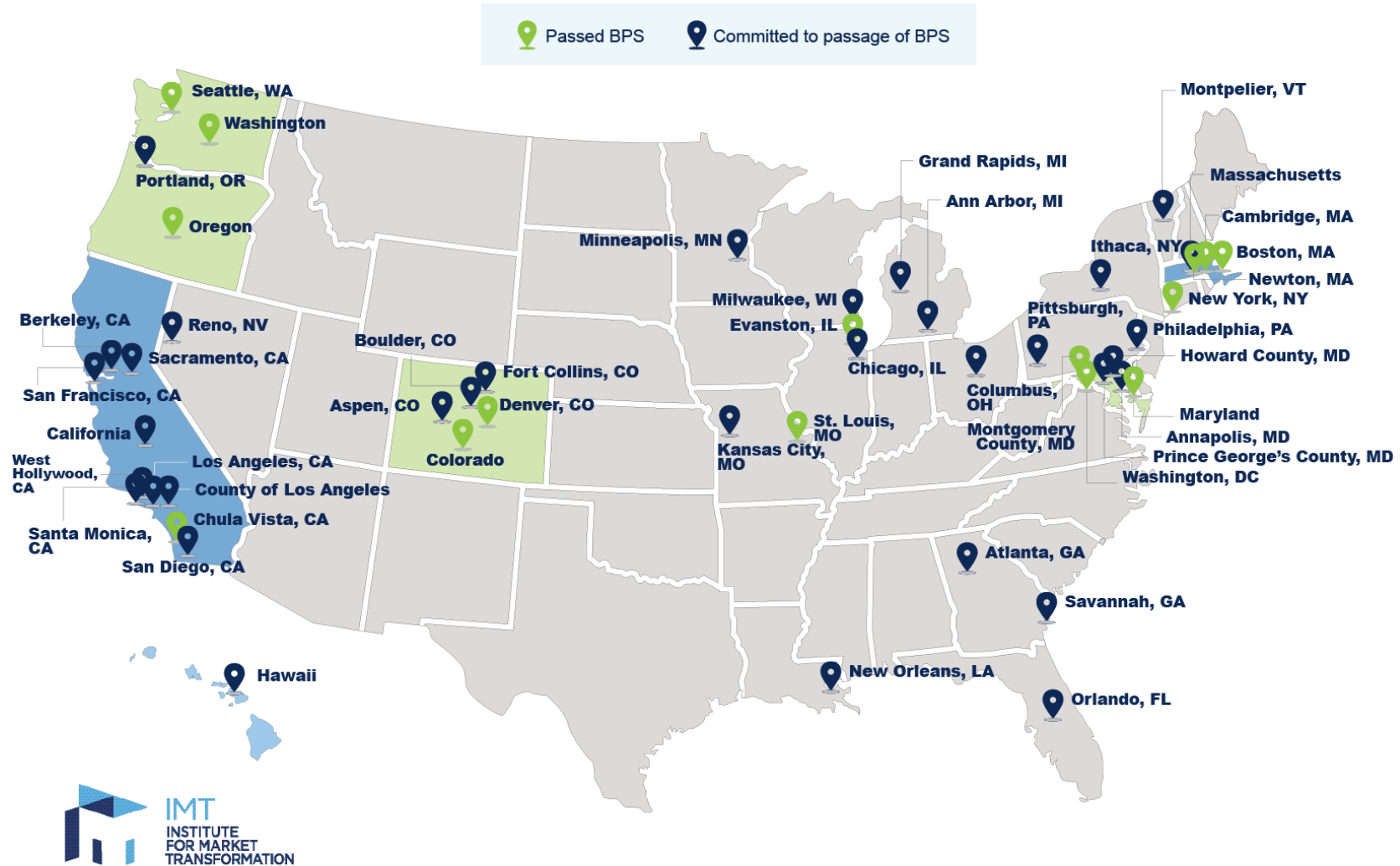
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<https://www.imt.org/public-policy/building-performance-policy-center/>

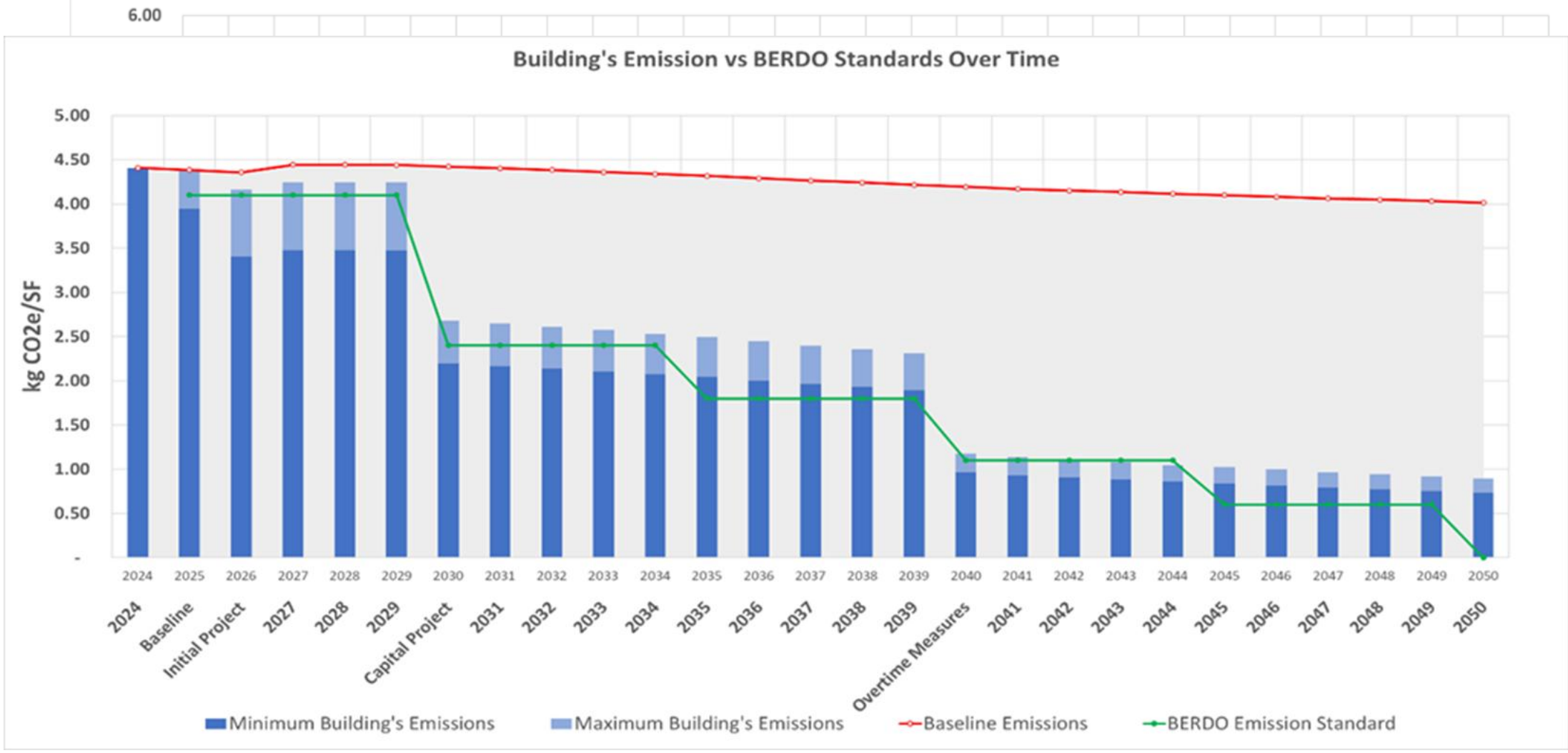
2025

The State of Building Performance Standards (BPS) in the U.S.

Members of the National BPS Coalition as of April 2025

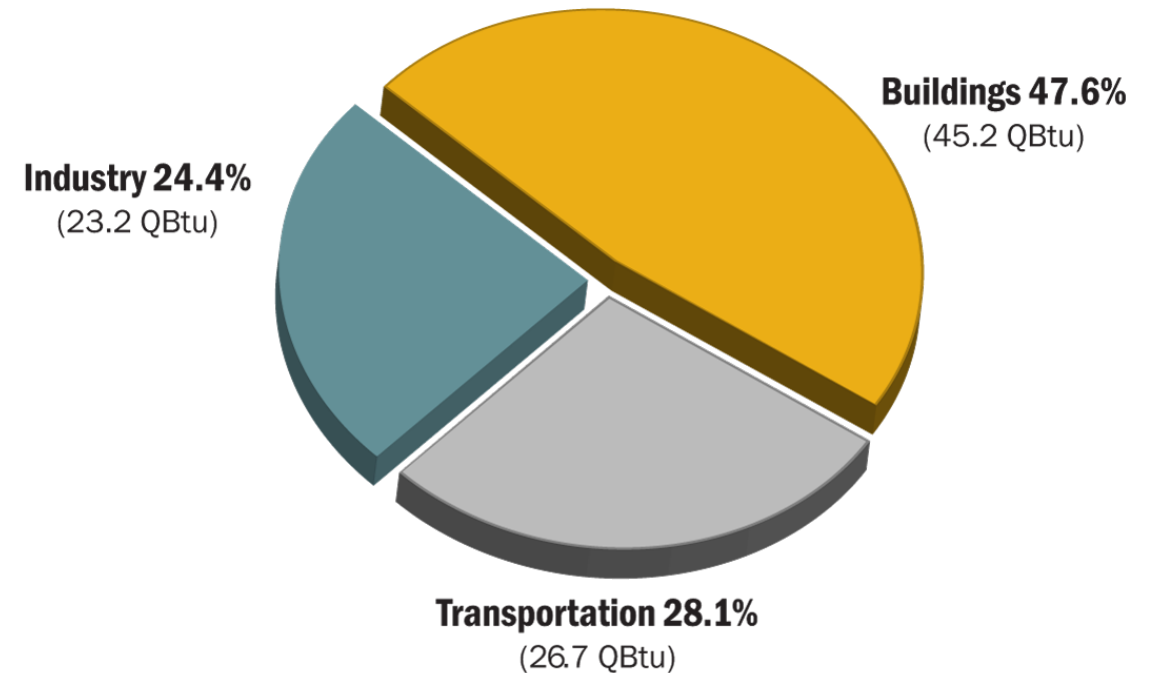


Zero Over Time (ZOT)



DECARBONIZATION APPROACHES

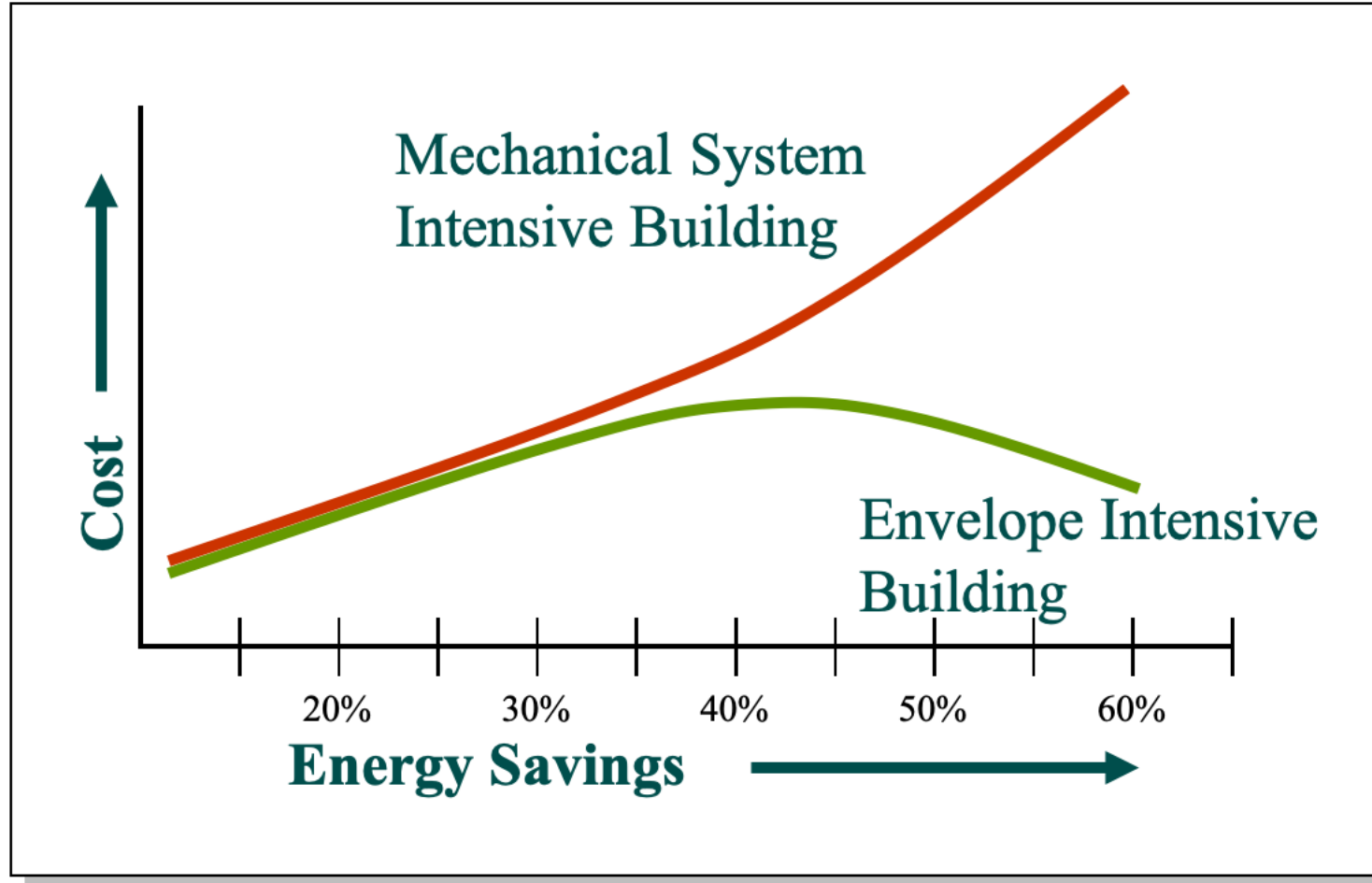
- Reduce Load
- Electrify
- Generate on Site



U.S. Energy Consumption by Sector

Source: ©2013 2030, Inc. / Architecture 2030. All Rights Reserved.
Data Source: U.S. Energy Information Administration (2012).

Reduce Load



Envelope Energy Savings



Envelope: Heat Loss

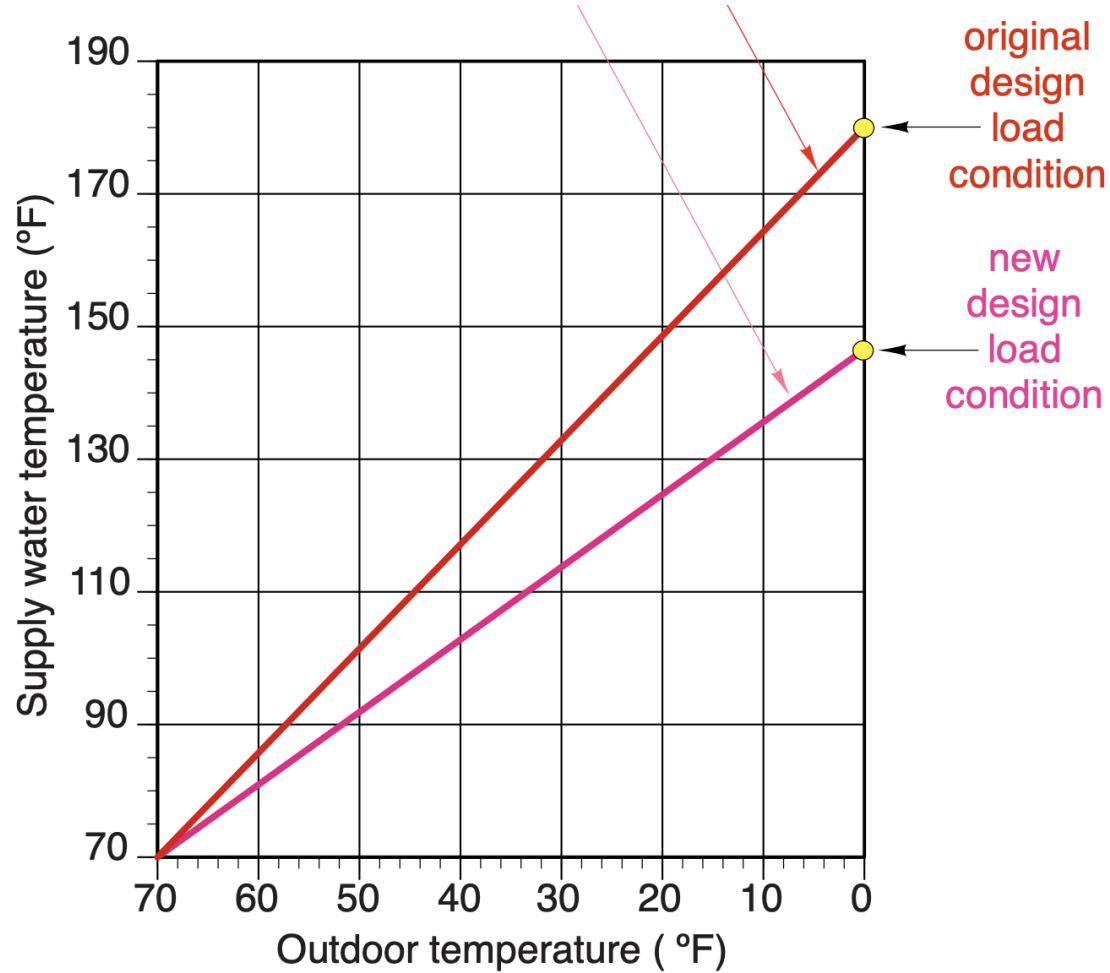
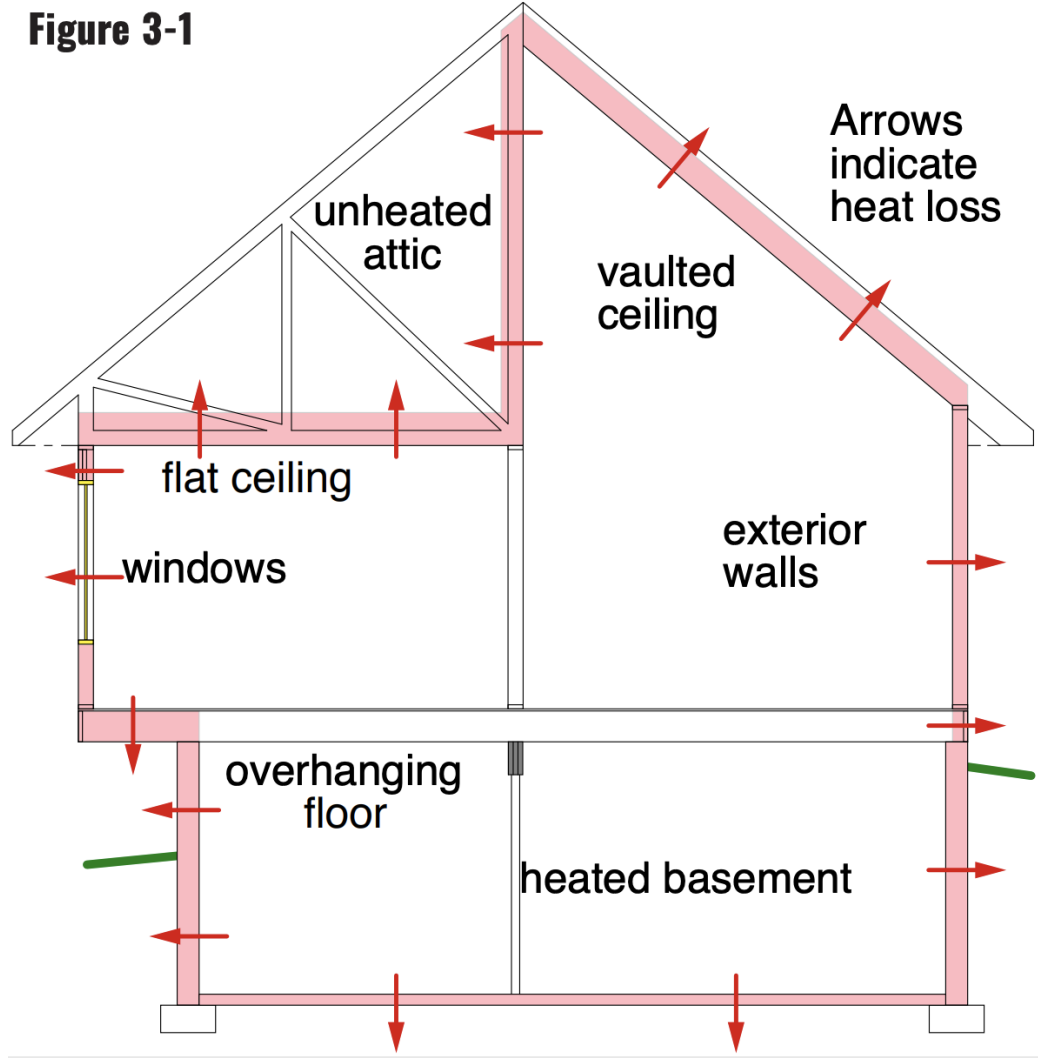
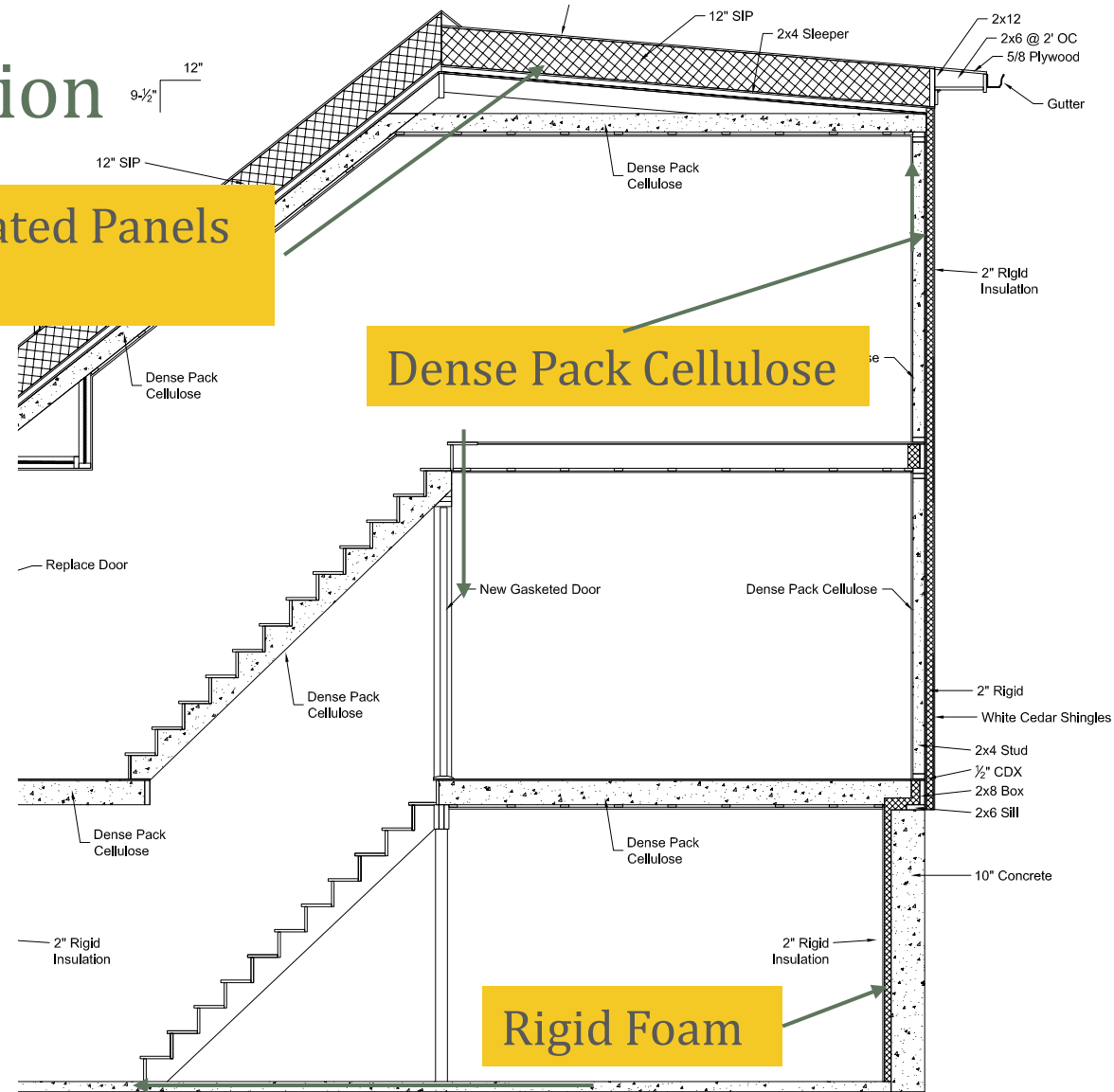


Figure 3-1



Envelope: Insulation

Structurally Insulated Panels (SIPs)



Section B

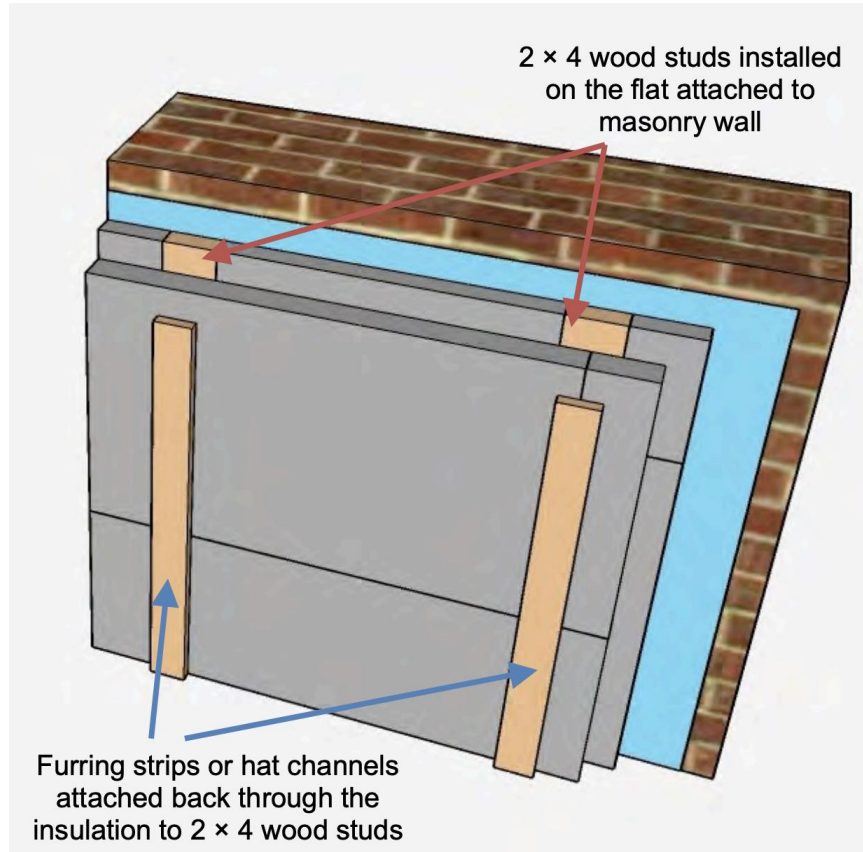
Envelope: Insulation

Structurally Insulated
Panels (SIPs)



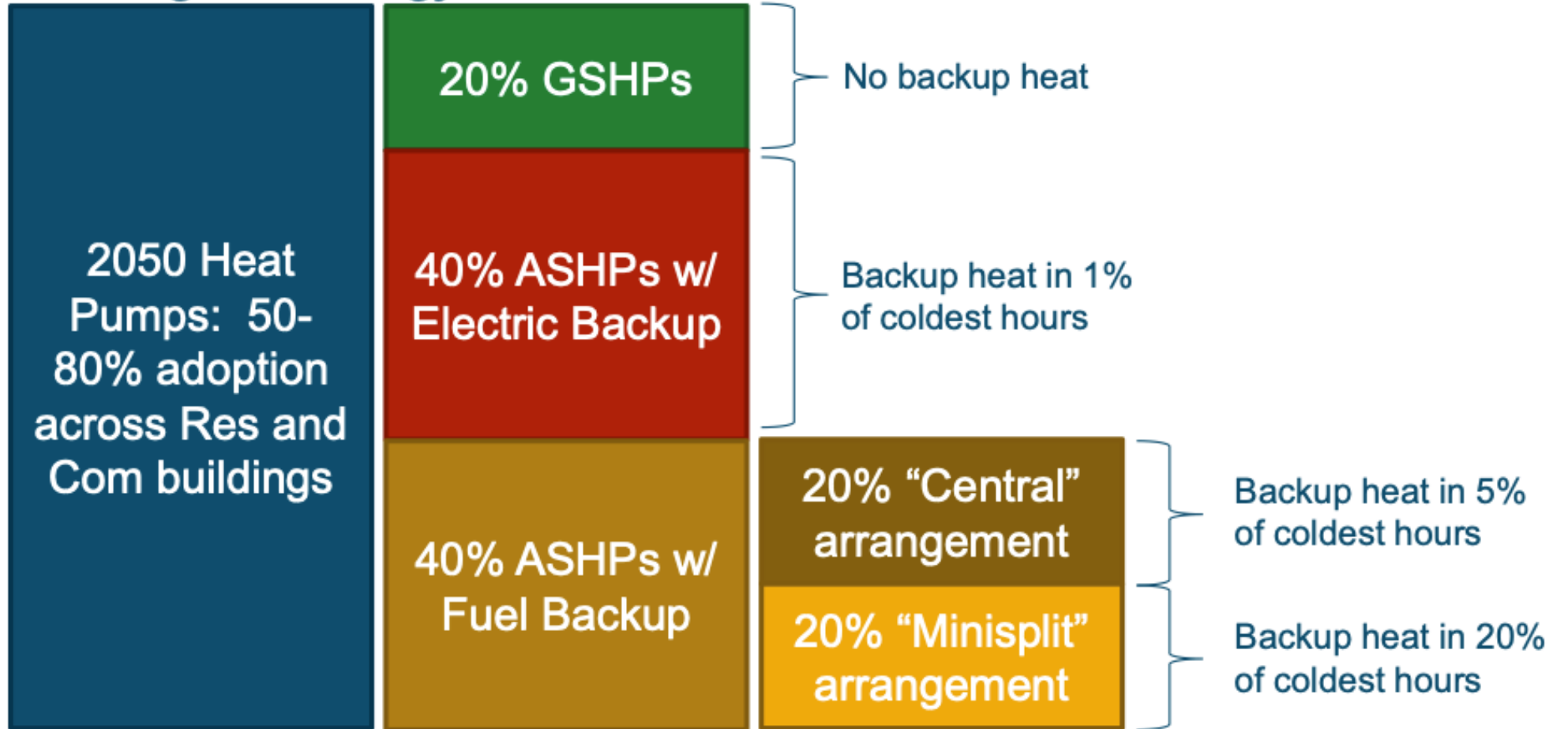


Envelope: Insulation



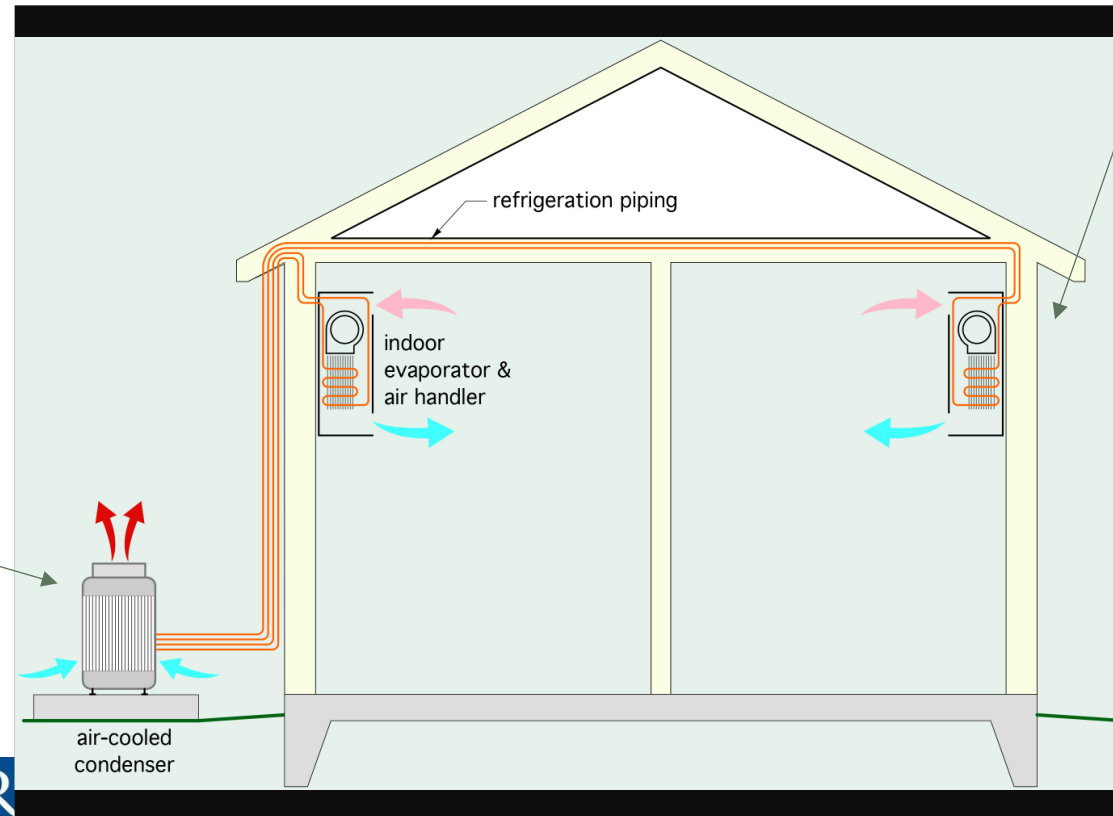
Equipment: Heat Pumps

Heating Technology Mix Assumed

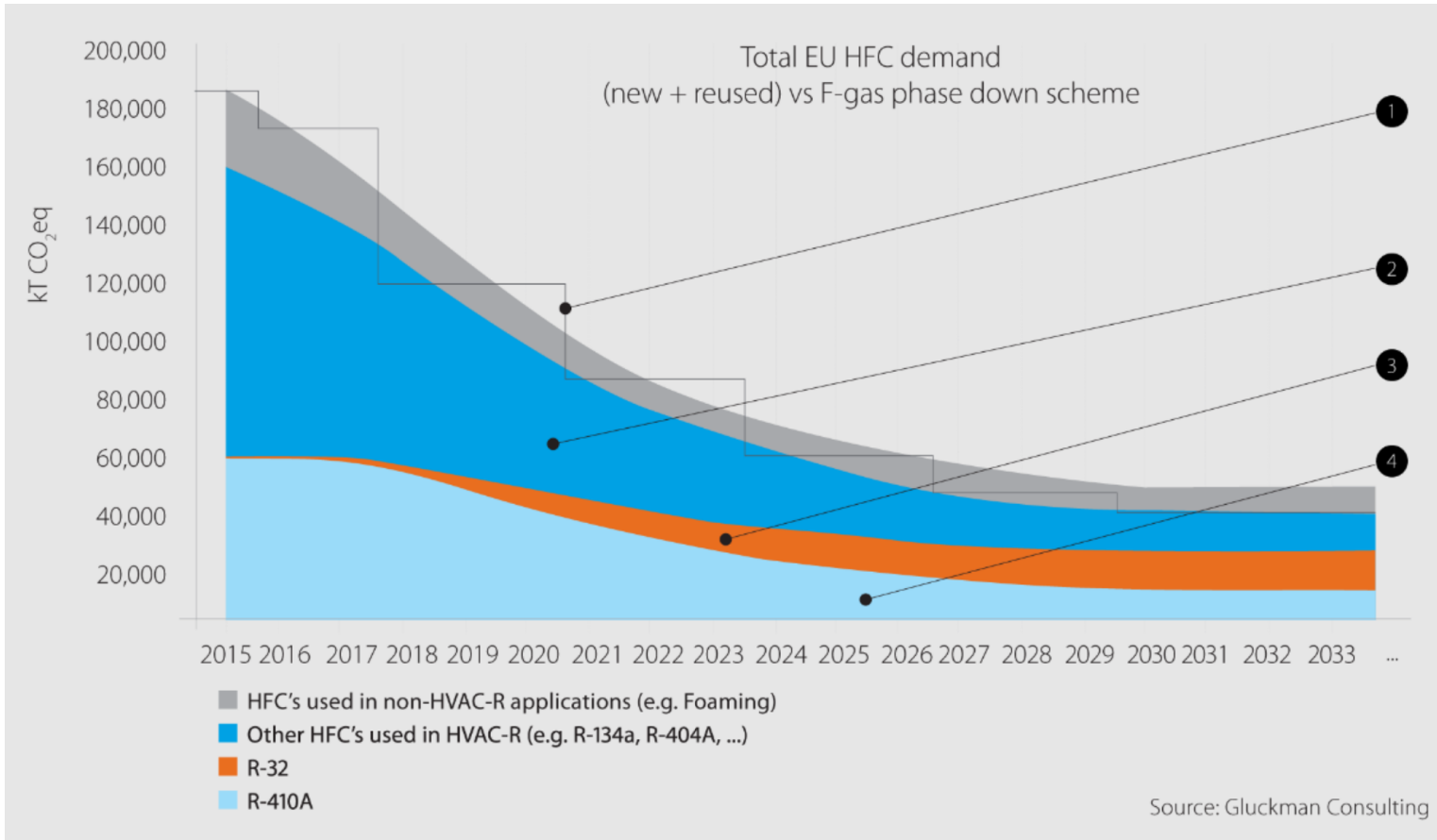


Heat Pumps: Air to Air

“Mini-splits”

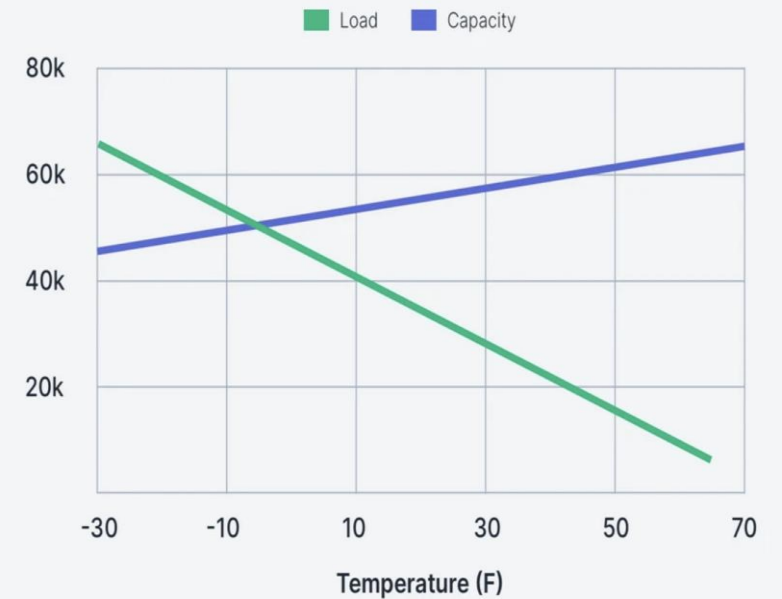


Challenge: Refrigerant Phase-out, temperature and time

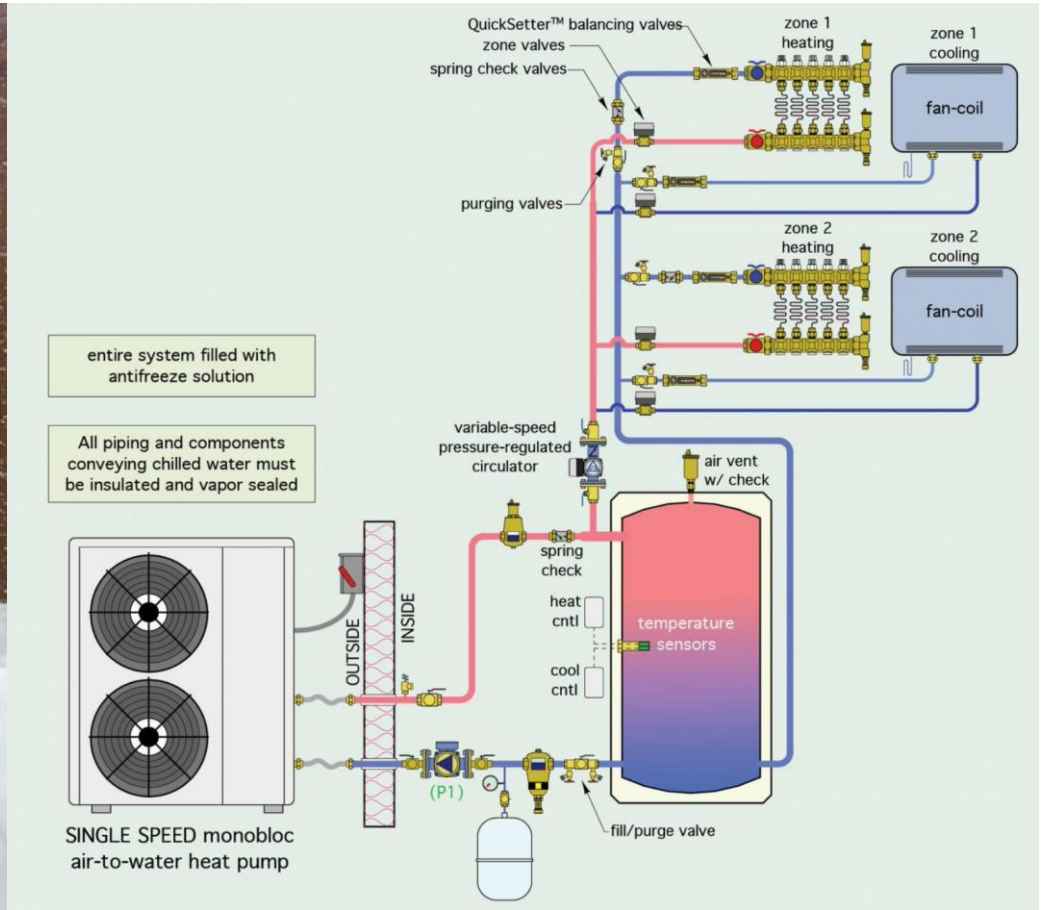
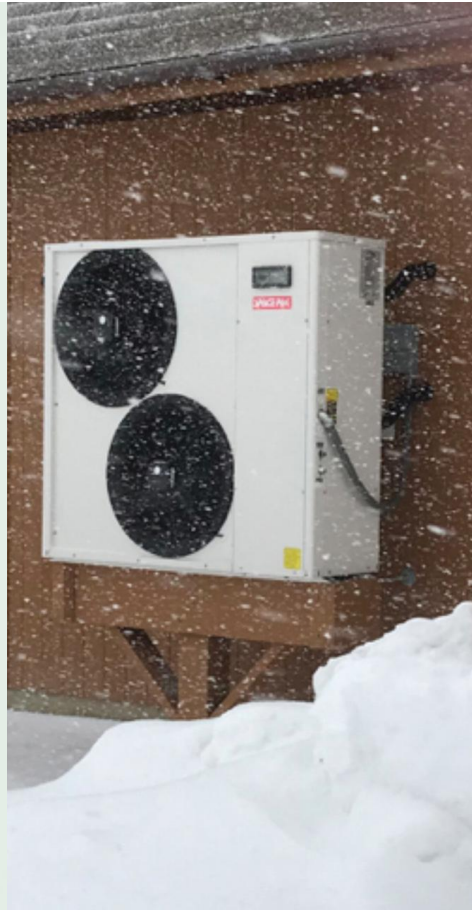
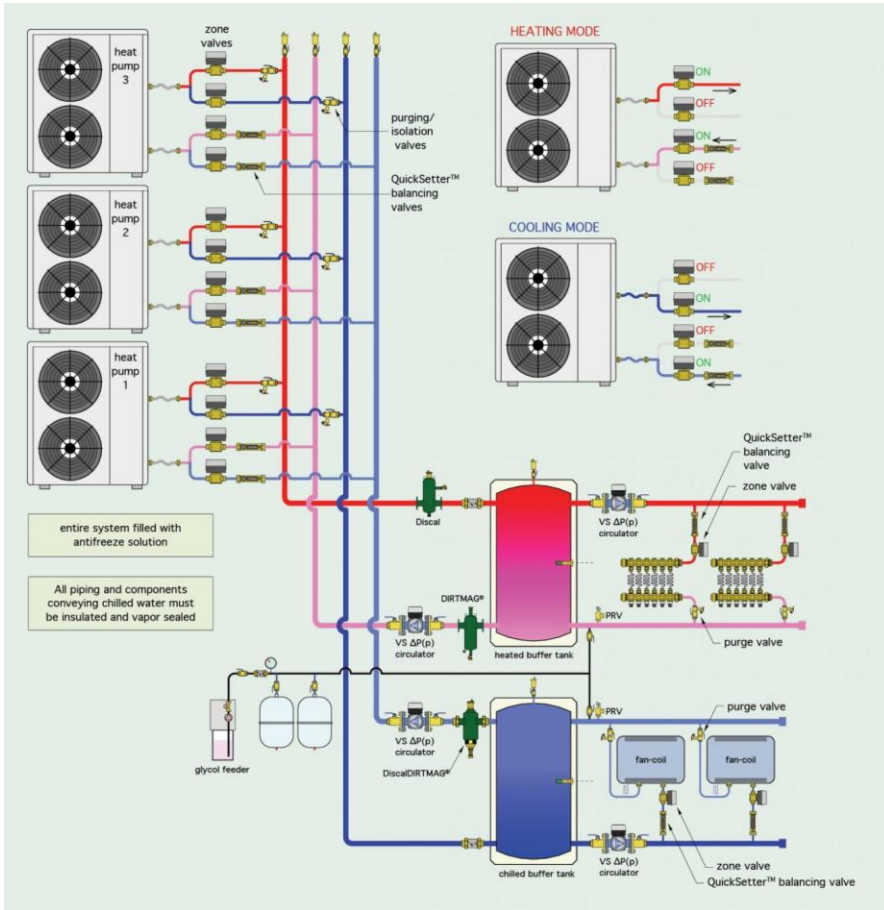


Colder weather means less capacity

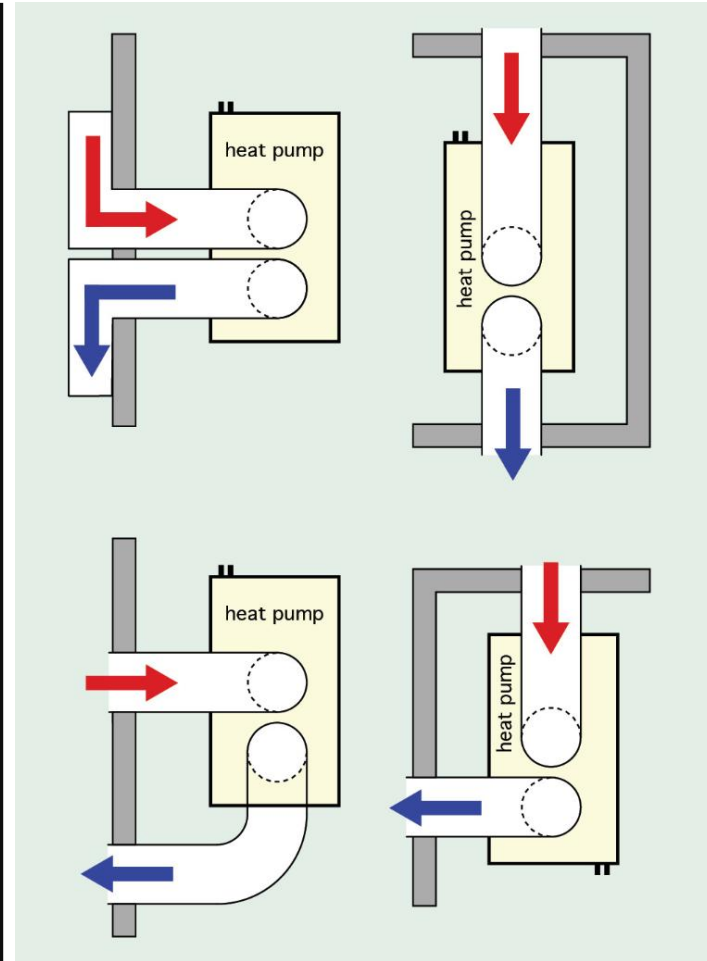
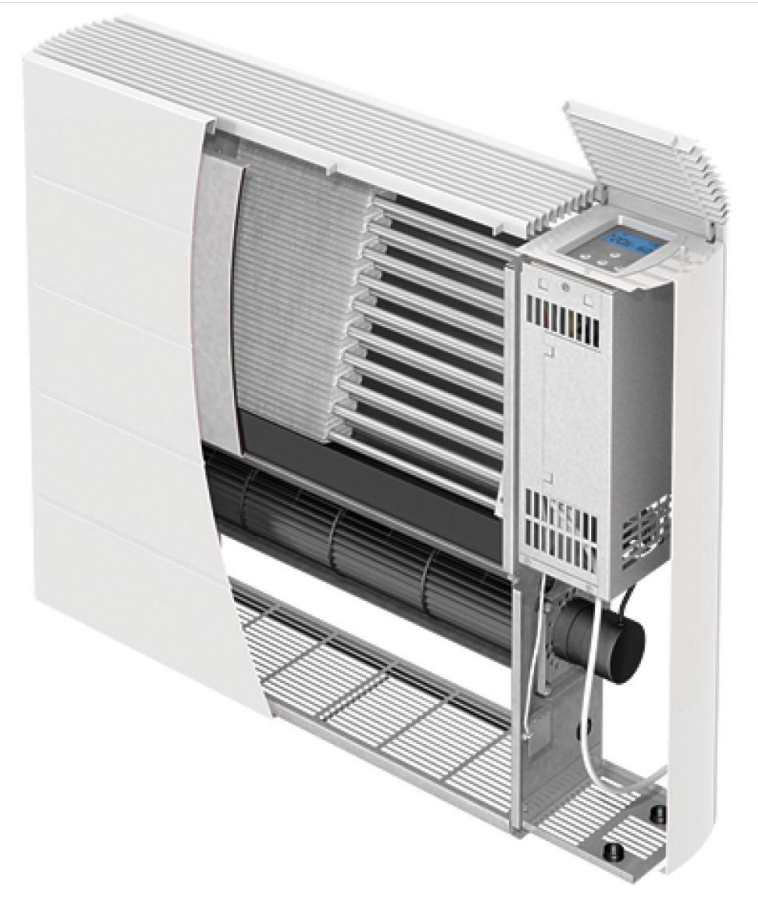
As the temperature drops, heat pump capacity falls



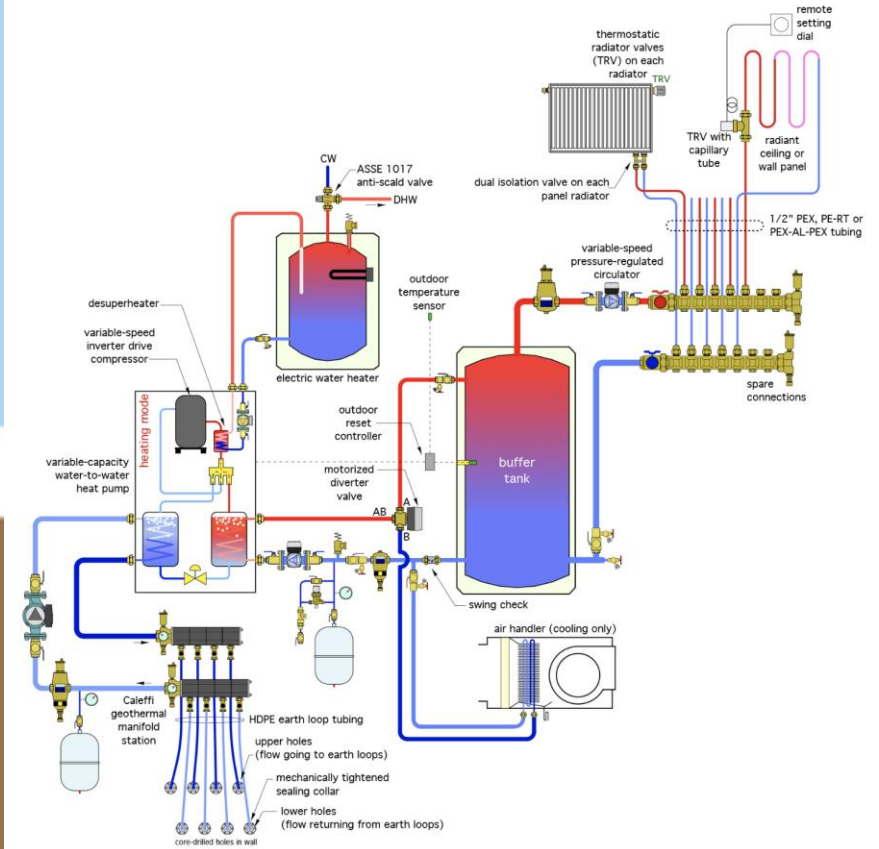
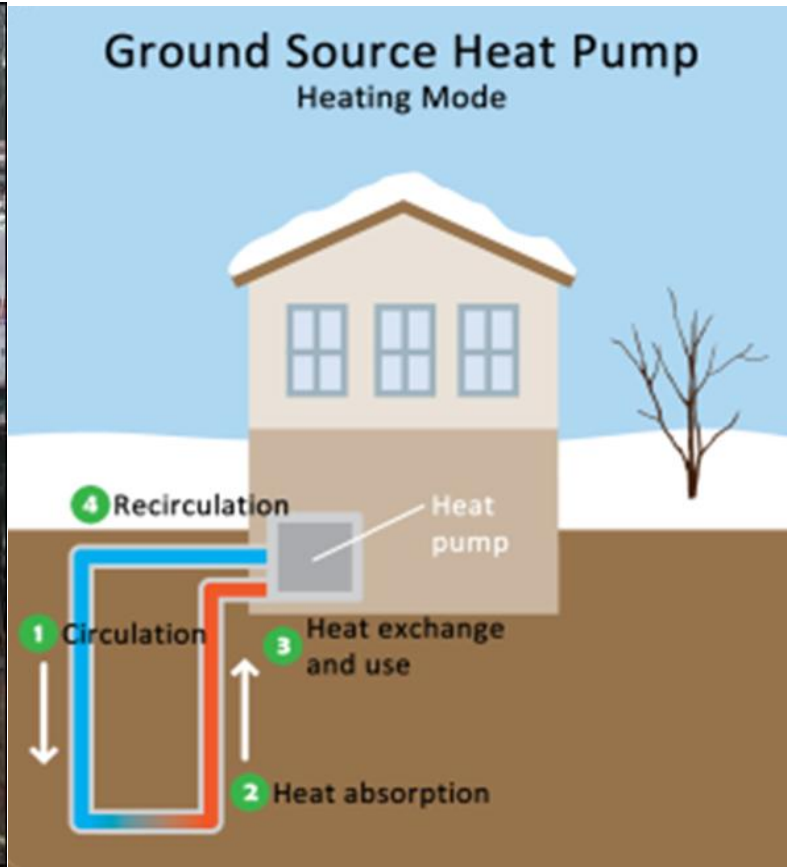
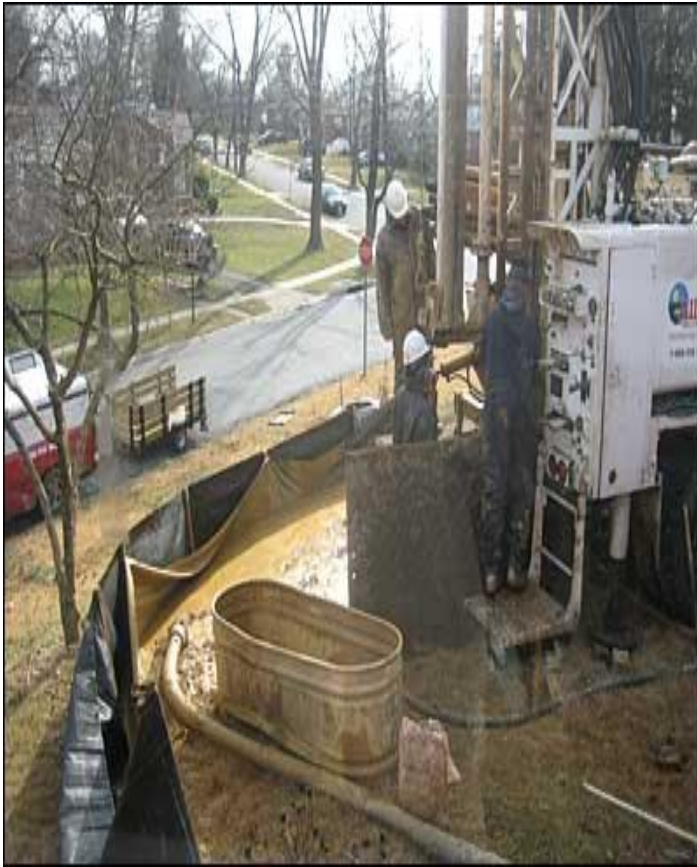
Heat Pumps: Heat pump to Water



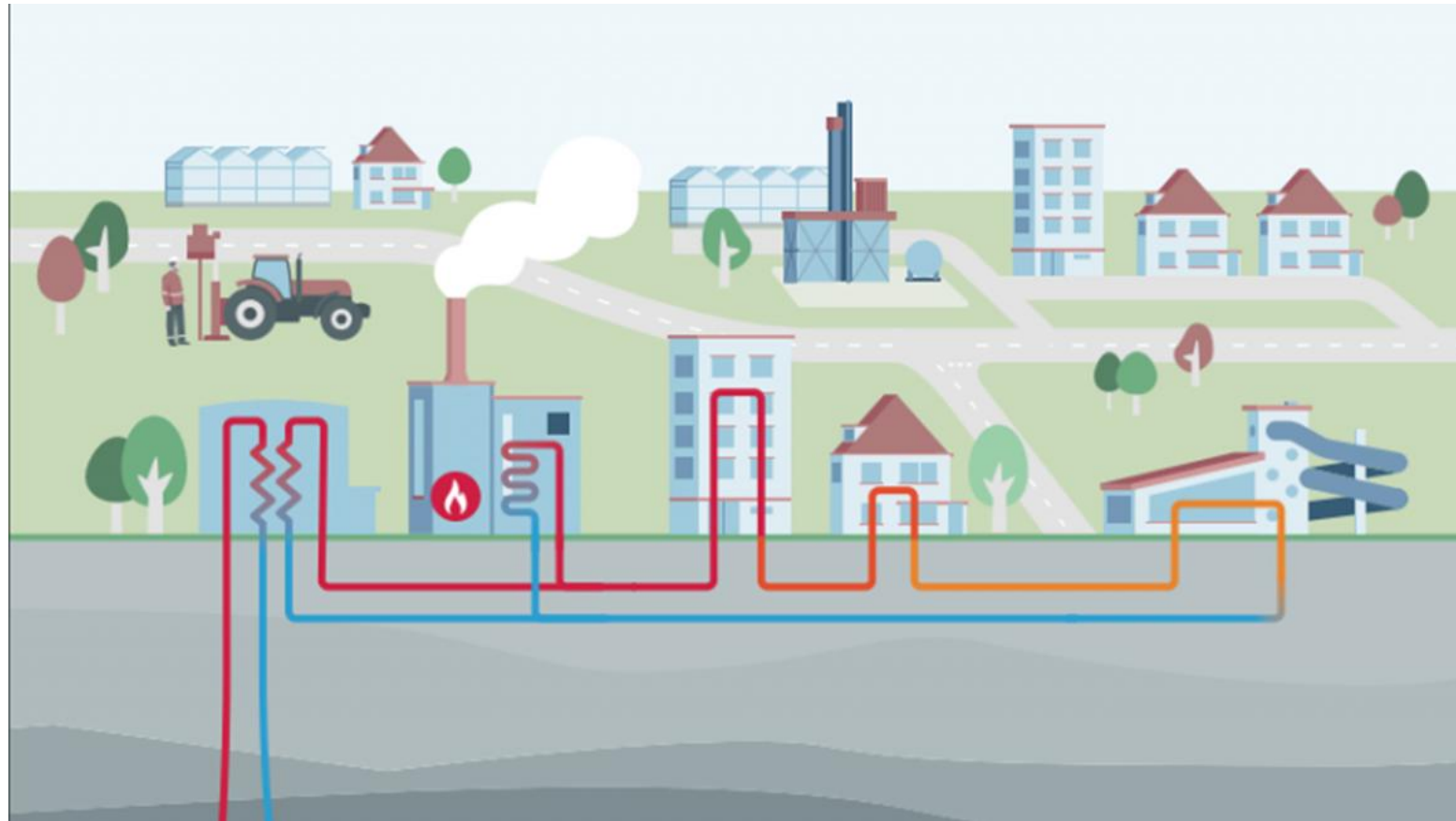
Heat Pumps: Air-Water-Air with the Outdoor unit Inside



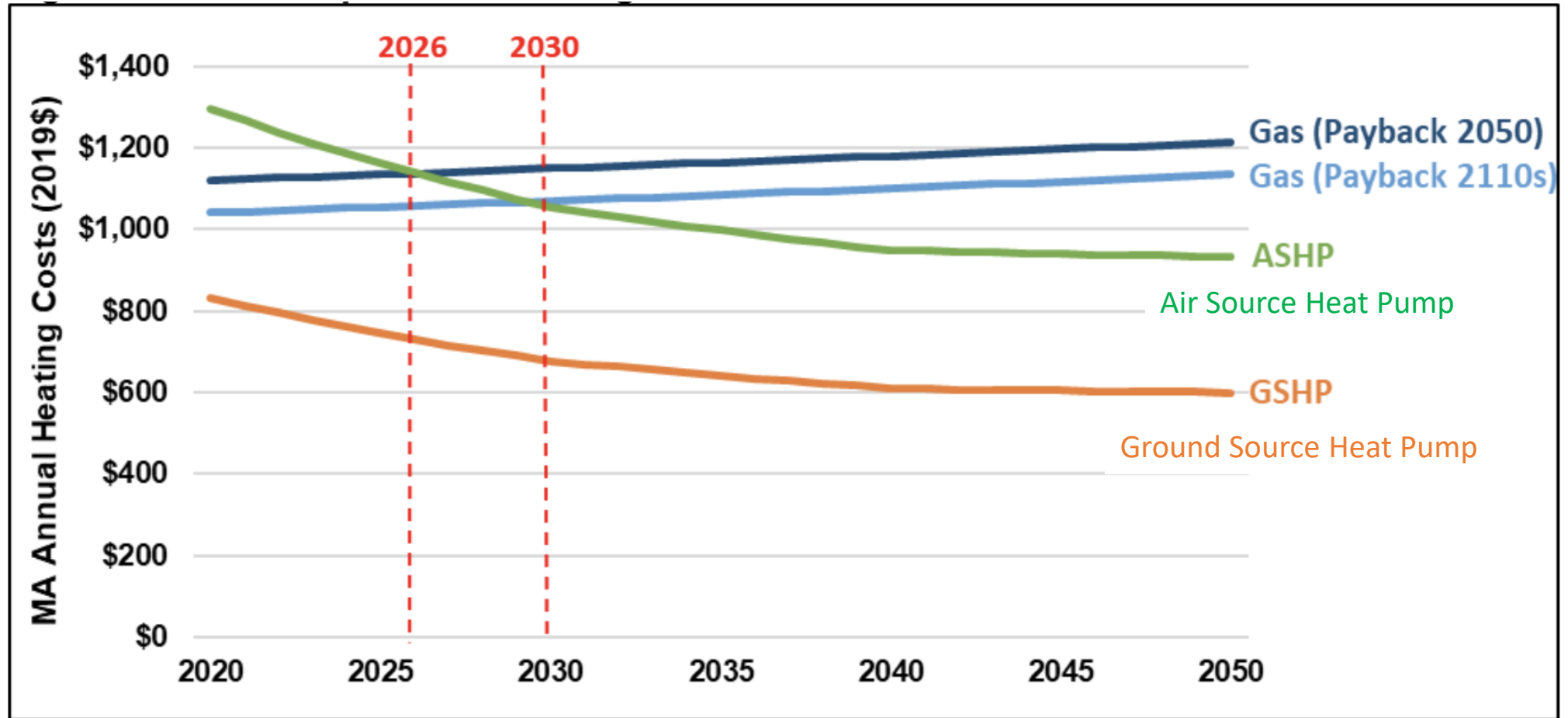
Geothermal: GSHP



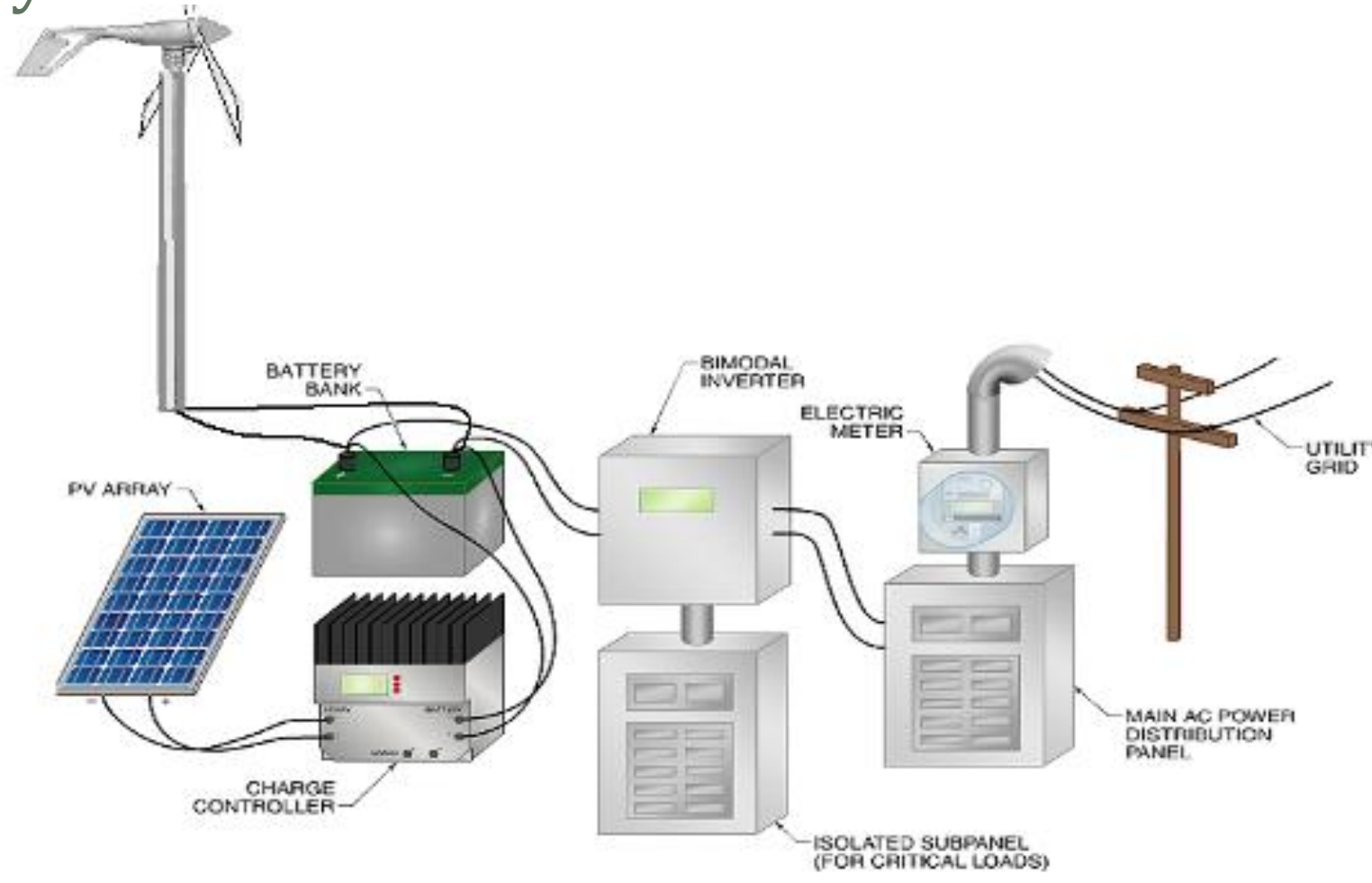
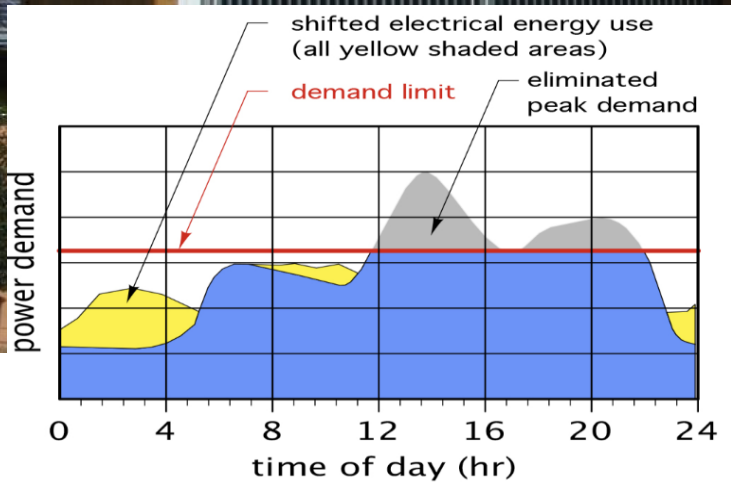
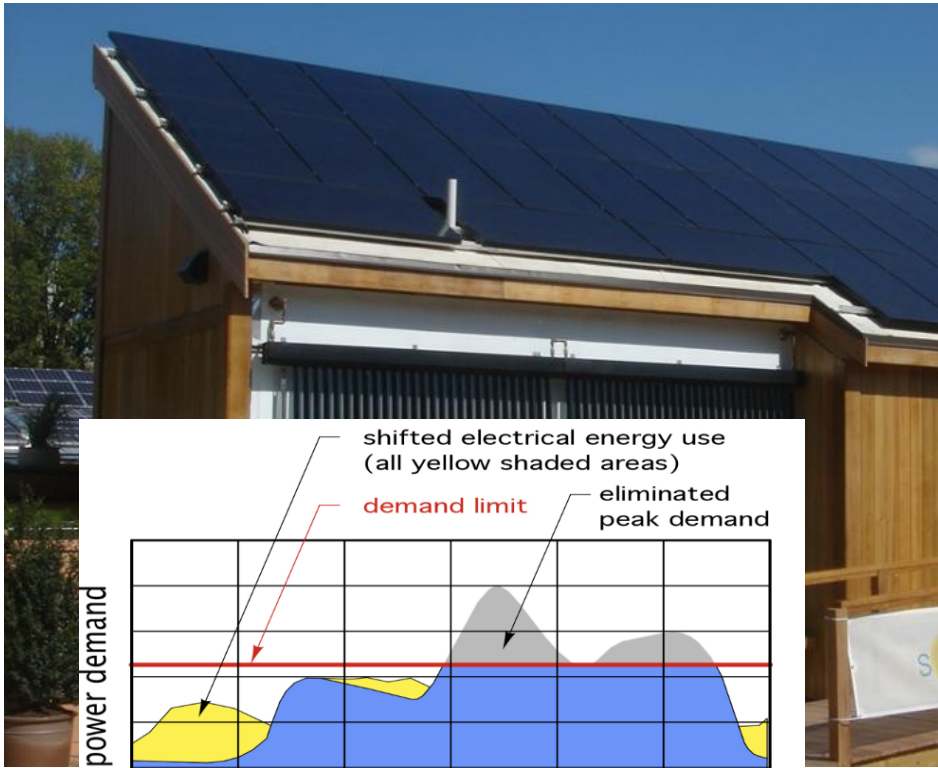
District Geothermal / Ground-source



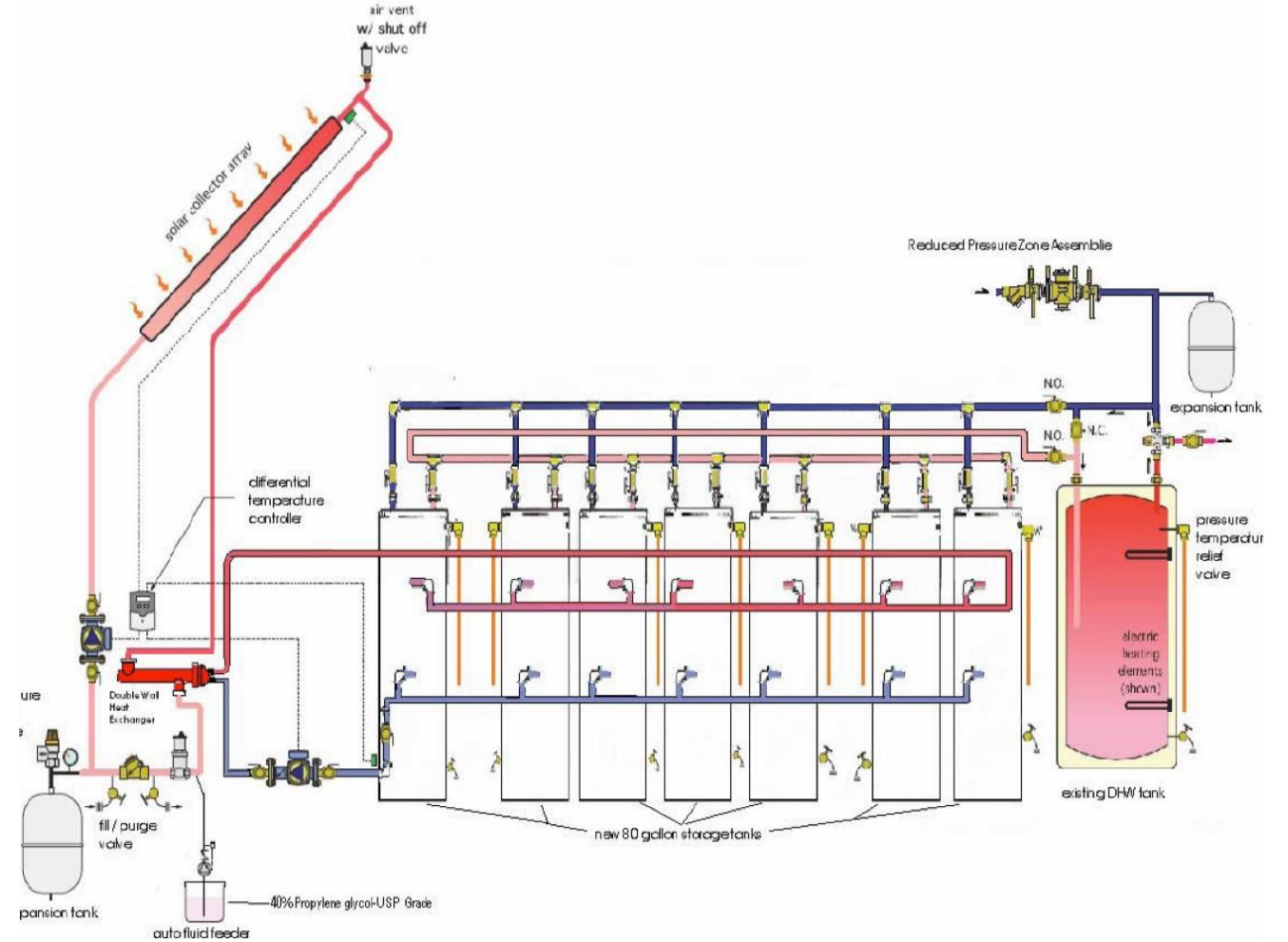
DRIVER: Fuel Costs



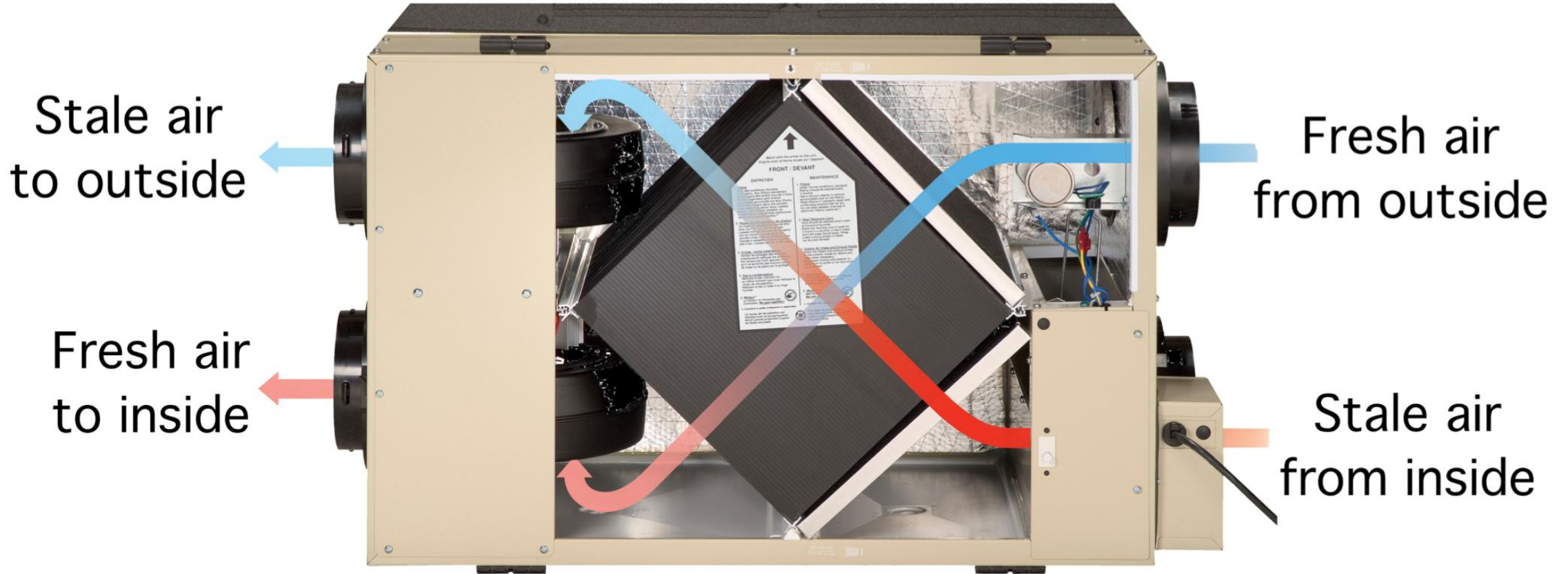
Renewables: Electricity



Renewables: Hot Water CO₂ Heat pump Vs. Solar thermal



Energy Recovery Ventilation (ERV)



Vulnerability and Risk Assessment

Sensitivity to a hazard and the **capacity to adapt** to the hazard.



Image: Virginia Living Museum



Image: Flood Panel

PROJECTS: Fine Arts Work Center

- What: Opportunity Assessment (ASHRAE Lvl 1) - 2 buildings
- Scope: Identify Carbon, Energy, and Water improvements for incorporation into Capital Planning
- Includes:
 - Historic Energy, Water Use Analysis
 - Deep Physical Inspection; Measurements
 - Vulnerability and Risk Assessment
 - Recommendations with Savings Estimates



Layers Controls & Legends Quick Zoom

Collapse All Hide All Remove All

Days > 90 °F (Projected)

Opacity: 100%
Summary: County
Decade: s
Season: Annual



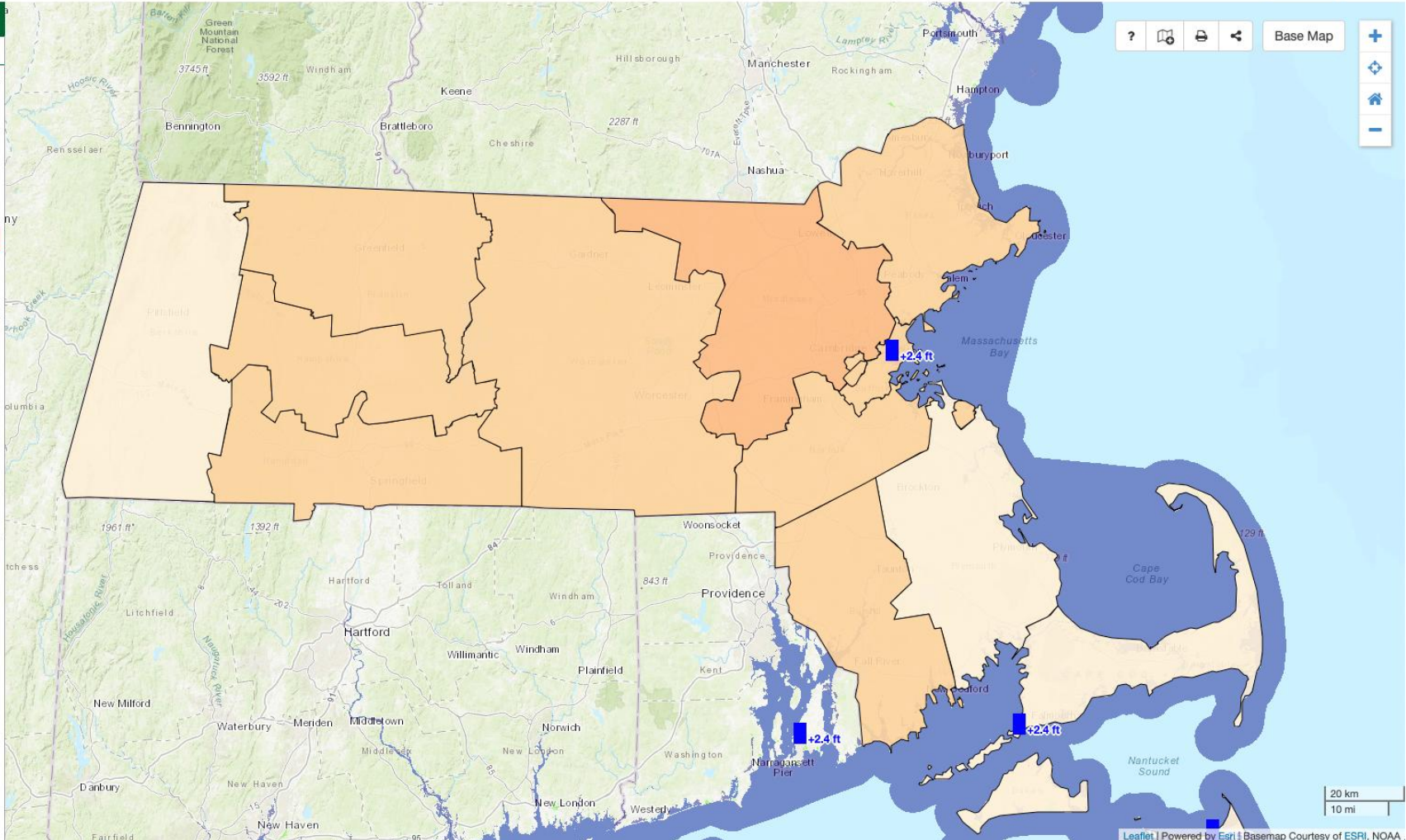
Sea Level Rise & Coastal Flooding (NOAA)

Opacity: 70%
Predicted Rise: 0 ft.
Layer: Sea Level Rise

Legend
Water Depth
Low-lying Areas
Area Not Mapped

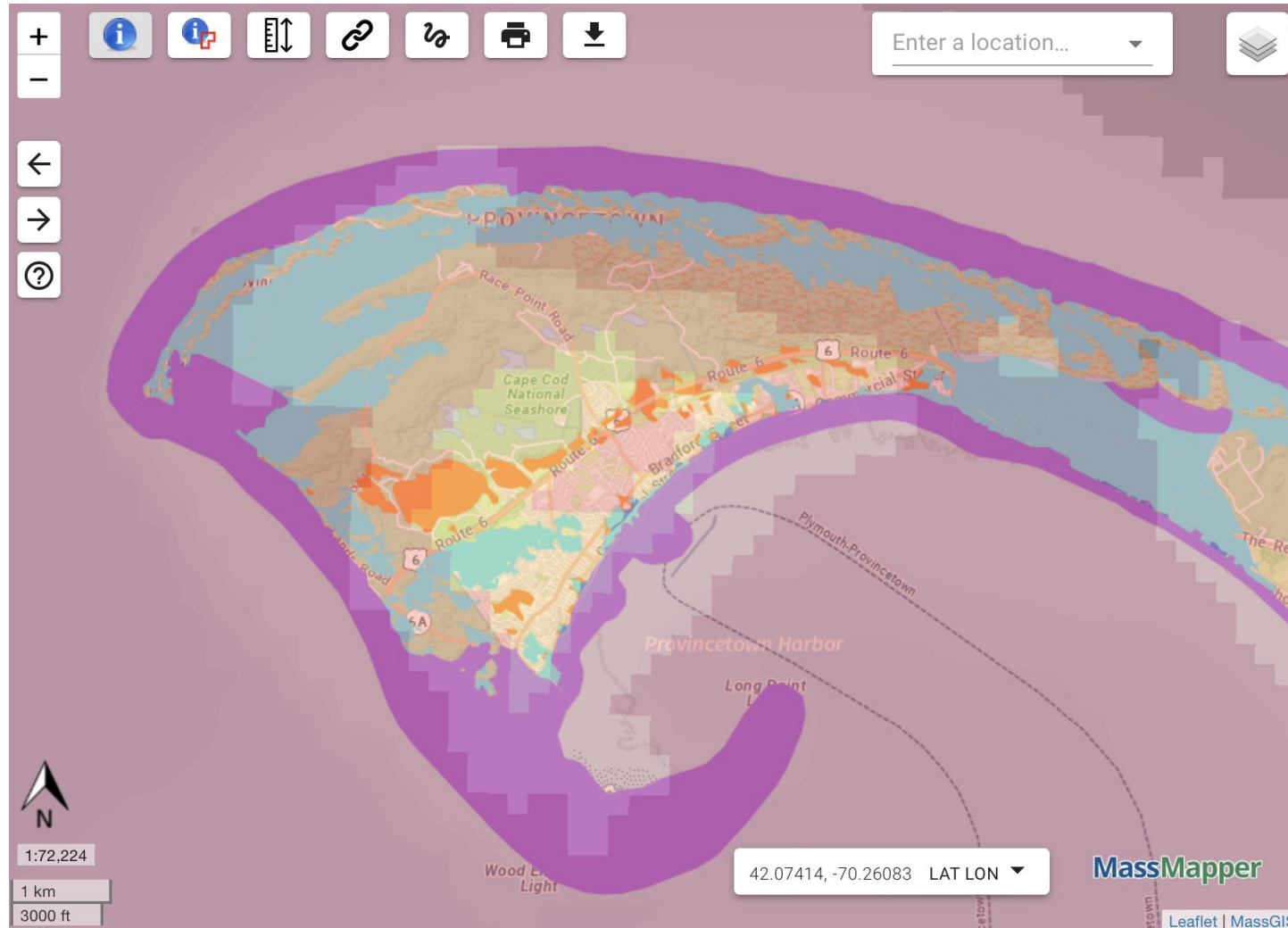
Sea Level Rise

Year: 2050
Scenario: High
Legend: Relative Mean Sea Level (feet NAVD88)



https://resilientma.mass.gov/rmat_home/designstandards/

Output from Resilient MA



- ✓ Climate Vulnerability
 - > Community Level Indicators
 - > Census Tract Level Indicators
 - > Census
 - > Coastal and Marine Features
 - > Conservation / Recreation
 - > Cultural Resources
 - > Environmental Monitoring (testing/monitoring sites)
 - > Flood Zones
 - > Images
 - > Index (grids/tiling schemes for certain layers)
 - > Infrastructure
 - > Physical Resources
 - > Political / Administrative Boundaries

Consider Co-Benefits!

Measure with Co-Benefits

- Insulation, Air Sealing, and Window Replacement
 - Heating and Cooling Energy Savings
 - Improved Passive Survivability
 - Improved Wind Load Performance
 - Improved Comfort
 - Improved Functionality
 - Reduced Maintenance

Measure without Co-Benefits

- Backup Generator
 - Increased Building Services
 - Increased Operations and Maintenance Costs

Cape Rep Theatre, Brewster

“Our challenge is that we have a 2,500 square foot open space that needs an HVAC system - but we don’t want to install a system fueled by natural gas in light of our global climate crisis.”



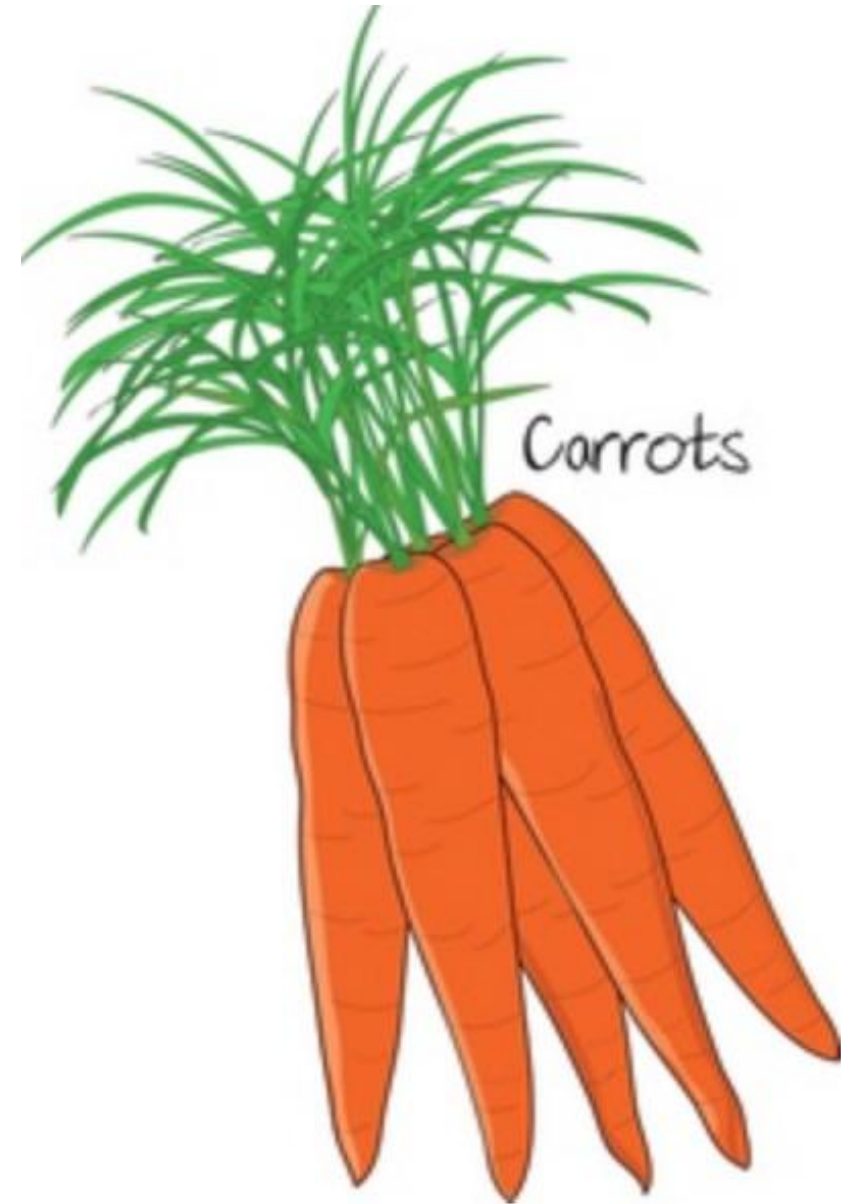
Questions:

- We’ve been told to switch to heat pumps. Is this correct? Is there new technology we should consider?
- Can the duct work system that was designed be adapted to electric instead of gas?
- How long will it take us to make this pivot?
- Can we convert or add in solar down the road?

RESOURCES

Mass Save Incentives

MassCEC BETA



Mass Save Incentives

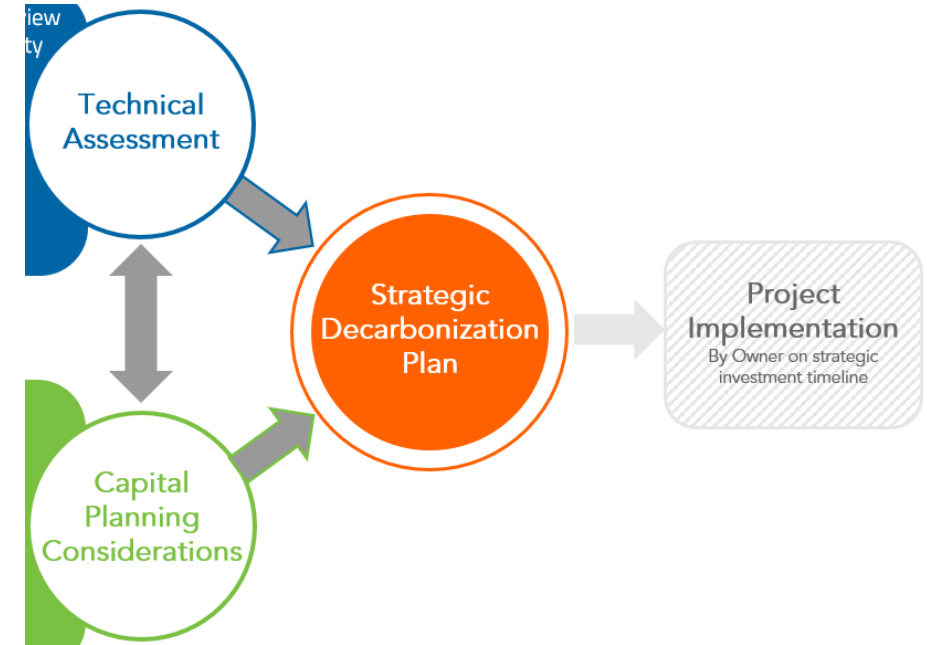
- Incentives for weatherization, electrification, & energy efficiency
- Resources for planning and technical assistance
- Eligible equipment rebates
 - Heat pumps, hot water heaters and more
- Additional program offerings for controls and Demand Response
- Examples of resources they've provided to cultural facilities



<https://massculturalcouncil.org/blog/cultural-facilities-mass-save-resources-for-energy-efficiency/>

BETA: Project Planning

- MassCEC pilot program to develop scalable models for commercial building electrification and decarbonization
- Offers no-cost, in-depth building audits to support electrification and retrofit planning
- Produces custom plans that inform market resources and pathways to full building electrification



<https://www.masscec.com/program/beta-project-planning>

—
Thank You
for your
Participation!

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